CLAIMS

What is claim is:

1) A bistable liquid crystal device comprising:

a first substrate having thereon a first conductive layer and a first alignment layer;

a second substrate having thereon a second conductive layer and a second alignment layer; and

a liquid crystal layer sandwiched between said first and second alignment layers, said first alignment layer inducing a first pretilt angle θ_1 in the range of 20°-65° between said liquid crystal layer in contact with said first alignment layer, and said second alignment layer inducing a second pretilt angle θ_2 in the range of 20°-65° between said liquid crystal layer in contact with said second alignment layer, said liquid crystal layer being capable of maintaining a stable bend state or a stable splay state at zero bias voltage and being switchable between said stable bend state and said stable splay state when a switching energy is applied in operation to said liquid crystal layer.

2) The device of claim 1, wherein said liquid crystal layer comprises liquid crystal having a positive dielectric birefringence when driven by electrical pulses at low frequency and a negative birefringence when driven by electrical pulses at high frequency.

3) The device of claim 1, wherein at least one of said first and second alignment layers comprises a mixture of vertical alignment material and horizontal alignment material.

4) The device of claim 1 further comprising input and output polarizers.

5) The device of claim 4 wherein said input and output polarizers respectively angle said alignment direction by ±40° to ± 60 °.

6) The device of claim 1 wherein said pretilt angles on said pair of substrates are substantially different.

7) The device of claim 1 wherein said pair of substrates have substantially parallel alignment directions.

8) The device of claim 1 wherein said switching energy is an electrical pulse generated by said first and second conductive layers.

9) The device of claim 1 wherein said switching energy is an electrical pulse having low frequency to align said liquid crystal layer to said bend state.

10) The device of claim 1 wherein said switching energy is an electrical pulse having high frequency to align said liquid crystal layer to said splay state.

11) The device of claim 1 wherein said switching energy is an electrical pulse providing an electrical field in a predetermined direction between said pair of substrates to switch said liquid crystal layer between said bend state and said splay state.

12) The device of claim 1 wherein one of said conductive layers further includes a patterned electrode to provide an electrical field in a predetermined direction between said pair of substrates to switch said liquid crystal layer between said bend state and said splay state.

13) The device of claim 1 wherein one of said conductive layers further includes a patterned electrode, said patterned electrode having an interdigital structure so that controlling the voltages on said interdigital electrode can apply either a vertical or

horizontal electric field upon said liquid crystal layer.

14) The device of claim 1 wherein said first and second conductive layers are patterned into stripes that are substantially perpendicular in direction to each other to form an overlapping matrix of pixels.

15) The device of claim 1 wherein both said first and second conductive layers are transparent.

16) The device of claim 1 wherein one of said first and second conductive layer is optically reflecting.

17) In a bistable liquid crystal device, said bistable liquid crystal device including a first substrate having thereon a first conductive layer and a first alignment layer, a second substrate having thereon a second conductive layer and a second alignment layer, and a liquid crystal layer sandwiched between said first and second alignment layers, a method for producing a bistable state comprising:
inducing a first pretilt angle θ_1 in the range of 20°-65° between said liquid crystal layer in contact with said first alignment layer;
inducing a second pretilt angle θ_2 in the range of 20°-65° between said liquid crystal layer in contact with said second alignment layer;
aligning said liquid crystal layer either in a stable bend state or in a stable splay state at zero bias voltage; and
applying a switching energy to said liquid crystal layer to switch said liquid crystal layer between said stable bend state and said stable splay state.

18) The method of claim 17 wherein applying said switching energy further comprises generating an electrical pulse by said first and second conductive layers.

19) The method of claim 17 wherein applying said switching energy further comprises applying a low frequency electrical pulse to align said liquid crystal layer to said bend state.

20) The method of claim 17 wherein applying said switching energy further comprises applying a high frequency electrical pulse to align said liquid crystal layer to said splay state.

21) The method of claim 17 wherein applying said switching energy further comprises generating an electrical field in a predetermined direction between said pair of substrates to switch said liquid crystal layer between said bend state and said splay state.

22) A bistable liquid crystal device comprising:

a first substrate having thereon a first conductive layer and a first alignment layer;

a second substrate having thereon a second conductive layer and a second alignment layer; and

a liquid crystal layer sandwiched between said first and second alignment layers, said liquid crystal layer having a positive dielectric anisotropy under a low frequency electrical field and a negative dielectric anisotropy under a high frequency electrical field, said first alignment layer inducing a first pretilt angle θ_1 in the range of 20°-65° between said liquid crystal layer in contact with said first alignment layer, and said second alignment layer inducing a second pretilt angle θ_2 in the range of 20°-65° between said liquid crystal layer in contact with said second alignment layer, said liquid crystal layer

being either in a stable bend state or in a stable splay state at zero bias voltage; and

being switchable between said stable bend state and said stable splay state when a switching energy is applied in operation to said liquid crystal layer.

17

23) A bistable liquid crystal device comprising:

a first substrate having thereon a first conductive layer and a first alignment layer;

a second substrate having thereon a second conductive layer and a second alignment layer; and

a liquid crystal layer sandwiched between said first and second alignment layers, said liquid crystal layer having a positive dielectric anisotropy and a cell gap-birefringence product of $0.31\pm0.1\mu m$, said first alignment layer inducing a first pretilt angle θ_1 in the range of 20°-65° between said liquid crystal layer in contact with said first alignment layer, and said second alignment layer inducing a second pretilt angle θ_2 in the range of 20°-65° between said liquid crystal layer in contact with said second alignment layer, said liquid crystal layer

being either in a stable bend state or in a stable splay state at zero bias voltage; and

being switchable between said stable bend state and said stable splay state when a switching energy is applied in operation to said liquid crystal layer.

16